

## SECTION [15141] [02516]

### DISINFECTION OF POTABLE WATER PIPING

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#### **LANL MASTER CONSTRUCTION SPECIFICATION**

Designate as 15141 when applied inside building; 02516 when applied outside.

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a subsection that does not apply). To seek a variance from applicable requirements, contact the Engineering Standards Civil POC regardless of where applied. When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3/ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

A. Disinfection requirements for the following new, repaired or modified systems:

1. Potable water distribution piping [on Project site and within buildings]
2. [Fire protection piping below grade to base of riser]

B. Dechlorination procedures for chlorinated water discharges

Note: Disinfection of non-potable water piping including fire protection piping downstream of alarm check valve or fire line backflow preventer is not required.

##### 1.2 LANL PERFORMED WORK

A. Water quality testing: LANL will perform water quality testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality. LANL will approve use of disinfected piping when test results demonstrate compliance with water quality requirements of the Safe Drinking Water Act as described in Section 1.3.D, furnishing disinfection report to Contractor.

##### 1.3 DESCRIPTION

A. Disinfection Requirements

1. Protect interiors of pipes, fittings, and valves against contamination during construction.
  - a. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material.

- b. Close openings of pipeline when pipe-laying is stopped at end of workday or for other reasons, such as rest breaks or meal periods.
  3. Do not disinfect any pipe until source of potable water supply used for flushing or disinfection is approved by LANL Construction Inspector.
  4. LANL will perform water quality testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality as described in Section 1.3.D.
  5. Do not place piping in service until notified by LANL Construction Inspector that water quality test results are approved by LANL, as described in Section 1.3.D.
  6. Re-flush and retest disinfected potable water piping that has been allowed to stand stagnant for more than 30 days before being placed in service.
  7. Disinfect piping within building with service taps and fixtures installed. Flow chlorinated water and flush water through lavatories, sinks, drinking fountains, showers, and hose bibs.
- B. Water Discharge Requirements – Contractor
1. Refer to Section 01325.
  2. Neutralize chlorinated water used for disinfection prior to discharge as described in “Dechlorination of Discharges (Neutralization)” Section 3.4.
  3. To discharge chlorinated/dechlorinated water, notify LANL Construction Inspector, as described in Section 1.3.D, to arrange for a total chlorine concentration test.
  4. Obtain approval from LANL Construction Inspector prior to ANY discharges.
- C. Water Discharge Requirements – LANL Construction Inspector
1. Refer to Section 01325.
- D. Water Quality Testing Requirements -- Contractor
1. Notify LANL Construction Inspector at least 48 hours (2 working days) in advance to arrange for a bacterial quality or free or total chlorine concentration test.
  2. Requirements for demonstration of compliance with the Maximum Containment Level (MCLs) of the Safe Drinking Water Act:
    - a. Total chlorine concentration of less than 1 mg/L (1 ppm).
    - b. The absence of any coliform bacteria.

- c. Less than 200 non-coliform bacteria per 100 mL sample.
- E. Water Quality Testing Requirements – LANL Construction Inspector
  - 1. LANL Construction Inspector will notify the Contract Safe Drinking Water Act (SDWA) Compliance Laboratory (667-0105) at least 24 hours (1 working day) in advance to arrange for a total chlorine concentration test, bacterial quality test, or for monitoring batch treated discharge for pH and chlorine.

## PART 2 CHEMICAL PRODUCTS

### 2.1 MATERIAL SAFETY DATA SHEETS

- A. Maintain on site Material Safety Data Sheets (MSDS) for chemical products, including disinfection and dechlorination products.

### 2.2 ACCEPTABLE DISINFECTANTS

- A. Sodium hypochlorite solution (bleach) contains approximately 5 – 6 percent available chlorine, or 50,000 to 60,000 ppm. Thus, a 1:1000 dilution of bleach in water results in a chlorine concentration of about 50 ppm. Use care in control of conditions and length of storage to minimize its deterioration.
- B. Calcium hypochlorite [ $\text{Ca}(\text{OCl})_2$ ] granules and tablets per AWWA B300. This contains approximately 65 percent available chlorine by weight. It will not readily dissolve in water with a temperature of less than 41 deg F. Store in a cool, dry, and dark environment to minimize its deterioration. Direct placement of solid phase into piping is not permitted. Do not use calcium hypochlorite intended for swimming pools (e.g., HTH), as this material has been sequestered and is extremely difficult to eliminate from the pipe.
- C. Disinfection with pure chlorine gas or liquid is not permitted.

### 2.3 ACCEPTABLE DECHLORINATION (NEUTRALIZING) AGENTS

- A. Use Vitamin C salt (sodium ascorbate, Vita-D-Chlor brand or equal) for discharges to a live stream [as it doesn't increase the alkalinity and it reduces the dissolved oxygen less than sodium thiosulfate]. Sodium thiosulfate (technical grade, prismatic rice) is acceptable for discharges elsewhere.
- B. Sulfur dioxide gas use is not permitted.

### 2.4 PRECAUTIONS

- A. Calcium hypochlorite is corrosive and is a strong oxidizer. Reducing agents (e.g., sodium ascorbate or thiosulfate), concentrated acids, and organic compounds (e.g. antifreeze, gasoline), can oxidize, burn or explode if they come into contact with solid-phase calcium hypochlorite.

- B. Do not use calcium hypochlorite on solvent-welded plastic pipe or on screwed-joint steel pipe because of danger of fire or explosion from reaction with joint compounds (exception: PTFE "Teflon" tape).

## PART 3 EXECUTION

### 3.1 DISINFECTION OF NEW WATER MAINS

- A. Preliminary flushing
1. Prior to disinfection, fill main with water to eliminate air pockets.
  2. Follow Section 01325 when discharging water.
  3. Flush new mains, including fire service mains and lead-in connections to fire system risers, thoroughly before connection is made to system piping in order to remove foreign materials that might have entered the main during the course of the installation or that might have been present in existing piping.
  4. The minimum rate of flow shall be greater than the water demand rate of the system, which is determined by the system design. Where the main supplies a fire supply sprinkler system (common at LANL), flow shall provide an NFPA 24 velocity of 10 ft/s (3 m/s) even if the demand rate may be less. Flow/velocity table below.
  5. Follow AWWA C651, "Disinfecting Water Mains," using Continuous Feed Method where practical.

Exception: For mains supplying fire systems, when the flow rate as listed in table below cannot be verified or met, supply piping shall be flushed at the maximum flow rate available to the system under fire conditions. This maximum rate shall be calculated by the water sprinkler system designer for each situation with the existing system limitations, if any, taken into account. The designer shall then submit the water demand rate of the new system to FWO-FIRE so they can set both the minimum rate of flow and the parameters for the test and flow rates. If such designer is not involved in the project, then FWO-FIRE will determine flush rate.

Flow Required to Produce a Velocity of 10 Ft per Second (3 m/s) in Pipes (NFPA 24)

Nominal Pipe Size (in.)	Flow Rate (gpm)	Flow Rate (L/min)
4	390	1476
6	880	3331
8	1560	5905
10	2440	9235
12	3520	13323

6. For all systems, the flushing operation shall be continued for a sufficient time to ensure thorough cleaning.
  7. Obtain verification from LANL Construction Inspector that system has been thoroughly cleaned (flushed) and is ready for chlorination.
- B. Chlorination of the Main
1. Inject chlorinated water, with a free chlorine concentration of not less than 25 mg/L, into main at a point no more than 10 feet downstream from beginning of new main. Verify free chlorine concentration of not less than 25 mg/L by an initial free chlorine concentration test as described in Section 1.3.D.
  2. Leave chlorinated water in main for at least 24 hours during which time valves and hydrants in system shall be operated to ensure disinfection of the appurtenances.
  3. At end of 24-hour period, treated water in all portions of main shall have a free chlorine concentration of not less than 10 mg/L. Verify this by a residual free chlorine concentration test as described in Section 1.3.D.
  4. After residual free chlorine concentration test has been completed, flush system with potable water until total chlorine concentration in main is less than 1 mg/L (1 ppm).
  5. After final flushing, contact LANL Construction Inspector to arrange for final total chlorine concentration and bacteriological quality tests as described in Section 1.3.D.
  6. After final total chlorine concentration and bacteriological quality tests have been completed, LANL Construction Inspector will furnish disinfection report to Contractor. If water quality tests do not show compliance with water quality requirements of the Safe Drinking Water Act as described in Section 1.3.D, repeat 1, 2, 3, 4, and 5 until test results demonstrate compliance.

### 3.2 DISINFECTION OF NEW INTERIOR POTABLE WATER SYSTEM

- A. Flush until discolored water is eliminated and water flows clear, discharging per Section 01325.
- B. Chlorination of piping
  1. Use chlorinated water, with free chlorine concentration of not less than 25 mg/L. Verify this by an initial free chlorine concentration test as described in Section 1.3.D.
  2. Retain chlorinated water in piping for at least 24 hours, during which time lavatories, sinks, drinking fountains, showers, and hose bibs shall be operated to ensure disinfection of appurtenances.
  3. At end of 24-hour period, treated water in all portions of piping shall have

a free chlorine concentration of not less than 10 mg/L. Contractor shall verify this minimum concentration by a residual free chlorine concentration test as described in Section 1.3.D.

4. After residual free chlorine concentration test has been completed, flush system with potable water until total chlorine concentration in piping is less than 1 mg/L (1 ppm), discharging as follows.
  - a. If total quantity of chlorinated waters is less than 20 gallons, it may be discharged directly to sanitary wastewater collection system without regard to chlorine concentration or Section 01325.
  - b. If total quantity of chlorinated water for disinfection is over 20 gallons, then:
    1. Neutralize and test disinfection water prior to discharge as described in Section 1.3 and "Dechlorination of Discharges (Neutralization)" Section 3.4 below, and
    2. Discharge to environment or sanitary sewer per Section 01325 requirements.

### 3.3 DISINFECTION DURING AND FOLLOWING REPAIR OR MINOR MODIFICATION OF EXISTING MAINS OR INTERIOR PIPING

#### A. Before Repair

1. Where practical, isolate a section of affected line and shut off all service connections.
2. Swab or spray the inside of new pipe and fittings with a minimum of 1 percent (10,000 ppm) hypochlorite solution before they are installed. Disinfect tools to be used in same manner.

#### B. Flushing after Repair

1. Prior to disinfection, flush affected line to clean out contamination introduced during repairs. If possible, flush from both directions. Flush until discolored water is eliminated and water flows clear. If line segment cannot be isolated, thoroughly flush the segment to a tank or through a fire hydrant. Follow requirements in Section 01325 for notification and possible dechlorination requirements.
2. Obtain verification from LANL Construction Inspector that affected line has been thoroughly cleaned (flushed) and is ready for chlorination.

- C. Apply chlorine to water to expose interior surfaces of affected segment at the chlorine concentration and contact times as follows; verify total chlorine concentration by an initial total chlorine concentration test as described in Section 1.3.D:

<u>Chlorine Concentration (mg/L, ppm)</u>	<u>Contact Time</u>
300	15 minutes
250	1 hour

200	1.5 hours
150	2 hours
100	3 hours

- D. Retain chlorinated water in main, or piping, for above prescribed contact time. At the end of prescribed time period, flush affected line with potable water until total chlorine concentration in main is less than 1 mg/L (1 ppm).
- E. After flushing, contact LANL Construction Inspector to arrange for final total chlorine concentration and bacteriological quality tests as described in Section 1.3.D.
- F. After final total chlorine concentration and bacteriological quality tests have been completed, LANL Construction Inspector will furnish disinfection report to Contractor. If water quality tests do not show compliance with water quality requirements of the Safe Drinking Water Act as described in Section 1.3.D, repeat E, F, and G above until test results demonstrate compliance.

### 3.4 DECHLORINATION OF DISCHARGES (NEUTRALIZATION)

- A. Provide mixing tank to allow dechlorination of water prior to discharge. Stir in neutralizer crystals allowed per Part 2 manually.
- B. If this is not practical or safe, contact LANL SSS-UWGW (667-7711) to arrange for direct injection into chlorinated water discharge pipe using a metering pump or venturi injector.
- C. Approximate dosage rate of neutralizer may be calculated from the following table:

<u>Free Chlorine Residual Concentration</u>	<u>Sodium Ascorbate (Vita-D-Chlor)</u>	<u>Sodium Thiosulfate</u>
10 mg/L	2.2 lb/10,000 gal	1.2 lb/10,000 gal
50 mg/L	11 lb/10,000 gal	6 lb/10,000 gal
500 mg/L	110 lb/10,000 gal	60 lb/10,000 gal

- D. Do not dose neutralizing chemical beyond the minimum required to neutralize the chlorine actually present in discharge. *Allowable residual chloride varies depending on discharge avenue (watercourse, flat land, or sanitary wastewater system); see Section 01325 for requirements.*

END OF SECTION

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Do not delete the following reference information:

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# FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification, Rev. 6, dated April 16, 2003.